"Never swap a running system": Transition to an alternative system as a strategy to resolve contradictions in the context of business and management

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Chapter 1

Introduction

"Never change a running system". This proverb is often used when talking about technical systems, especially in the context of modern software systems. To change a running system invokes the thought of an accident, or the destruction of said system. The solution is obvious: stop the system and change it then. But this is not always possible. One such context is business and management. Companies, the market and the environment are ever-changing and connected by various relations, influencing each other constantly. At the same time, the change needs to be controlled and steered into the direction of the desired outcomes. But it is hard to imagine how it would be possible to replace parts of a company or a central process within a company.

The monograph "Hands-On Systematic Innovation For Business and Management" by Darrell Mann proposes a systematic approach to innovation in business. This seminar paper sheds light on the proposed solutions to eliminate contradictions, in particular to the strategy to "Transition to an Alternative System", and its associated difficulties.

Chapter 2

Defining Systems and Understanding TRIZ

Before we inspect the process of systematic innovation and the tools to work with contradictions, we need to define underpinning terms and understand the theories of TRIZ. We start with the fuzzy term *system*.

2.1 Systems

The term *system* can be understood in many different ways. The definition of the Merriam-Webster strives towards a generalized definition: A system is "a regularly interacting or interdependent group of items forming a unified whole". The examples provided are diverse, as they list "a group of related natural objects or forces" such as a "river system" or "a group of interacting bodies under the influence of related forces" such as the "gravitational system", but also a "a group of devices or artificial objects or an organization forming a network especially for distributing something or serving a common purpose" such as a "computer system". The examples illustrate how the term "system" can be used in any discipline and show how the specific context of each discipline entail a different understanding of the term. This is necessary to be able to work with the term "system" and its parts and their respective relation. More abstract examples of systems as "an organized set of doctrines, ideas, or principles usually intended to explain the arrangement or working of a systematic whole" help to grasp the relationship of principles and ideas, which are abstract themselves, but become harder to work with due to the high level of abstraction.

When working with technical systems, a more concise definition is necessary to be able to work with the term "system". Gräbe proposes following understanding of the term *system* which is independent from a specific field: "A system is a delimited set of components. Their interaction realises a qualitatively new function (emergent property) and thus constitutes a new unified whole." [3, p. 2] This definition enables the practitioners who analyses or works on a system to clearly identify the set of components and the purpose of the system, described as the "emergent property" here. The last part of the definition hints at a contradiction of systems in operation and their description when addressing the fact that a system is more than its components. To elaborate on this point, we need to be aware that the description of the system and the system in action are not the same thing. The description of a system is needed to analyse a system, while in practice we want the system to operate according to its the purpose to produce the desired outcome. In the moment of describing a system, we need to decompose the system into their respective components and (re-)structure these components, while thinking about and defining the relations between them. In the moment of operating a system, we need to put the system into motion and rely on the components to fulfill their purpose. This mode emphasises the indecomposability of the system.

So need to rely on words and visualisations, which are always a form of reduction, when describing a system. This reduction is necessary to describe a system, but due to the context of the system and the emergent function of a system we are never able to capture the system and its context completely. So when planning and designing a system or its transformation, we need to keep in mind that we are always working with a description of the system instead of the system itself. Therefore the description should be performed cautiously and with the goal of reducing the system to the essential components and relationships. This inherent contradiction of working with systems becomes more important in the context of socio-technical and socio-economical systems, which are relevant in business and management (see 2.3).

The following observation of Gräbe [2, p. 5] takes this contradiction into account when defining technical systems as needing reduction in three dimensions:

1. "Outer demarcation of the system against an environment, reduction of these relationships to input/output relationships and guaranteed

throughput."

2. "Inner demarcation of the system by combining subareas to components, whose functioning is reduced to “behavioural control” via input/output relations."

3. "Reduction of the relations in the system itself to “causally essential” relationships."

Following this logic, Gräbe argues that technical systems are socio-technical systems "in their performance dimension" due to the fact that the reduction to the essentials needs to be based on the operating system, so when the system is actually in use, and is therefore embedded into a supersystem where a social context exists [2, p. 5]. This is relevant in the context of the application of TRIZ in a business context and will be elaborated upon in section 4. The previously specified general definition of a system can be contextualised with the three dimensions of reduction: Outer demarcation is needed to describe the system in relation to its environment, so for any kind of description in general. Inner demarcation enables us to identify distinct components. And the reduction to the essential relationships draws the focus to the emergent function of the system.[1]

With this understanding of the term *system* we can proceed to focus on TRIZ and how it can help to plan or transform systems.

2.2 TRIZ

TRIZ is an abbreviation for "Theory of Inventive Problem Solving". The acronym stems from the Russian term "Теория Решения Изобретательских Задач". Initially developed by the Russian inventor, engineer, author and scientist Genrich Saulowitsch Altschuller, TRIZ aims to generalize the process of finding inventive solutions across disciplines. The theory is based on analysis of patents of technical inventions. As a result, it is shown that technical systems follow laws of evolution. So TRIZ is a combination of theories, strategies and tools to define and solve problems in a systematic way. Therefore, it is both a scientific theory and a framework to be applied to real world problems [6, p. 21-22].

[1] The connection between essential relationships and the emergent is elaborated upon in section 3.1 "Systems and Emergent Functions" in [4].

The process of TRIZ defines a specific problems, reformulates this as an abstract problem and looks for an inventive solution for the abstract problem. This abstract solution is guided by the knowledge base of TRIZ. Then the abstract solution is reformulated into a specific solution. This process sets up the broader framework of TRIZ. But it also provides systematic methods for each step: The definition of the goal, the analysis of the problem situation and its constraints, the synthesis for an inventive solution and the evaluation of said solution [6, p. 30-31].

For this paper the aforementioned theory and its methods are referred to as "Classic TRIZ", although the methods and strategies of TRIZ are ever evolving. The monograph "Systematische Innovation - TRIZ-Anwendung in der Produkt- und Prozessentwicklung" of Koltze and Souchkov [6] serves as a baseline for the understanding of "Classic TRIZ" in this work. Furthermore, the person or team applying TRIZ to the given context will be referred to as "practitioners" from here on. This term is in contrast to the theoretical foundations which is developed systematically and scientifically - however, the operationalization of TRIZ must be done in practice and is performed on a real system. The term "practitioners" is chosen with this juxtaposition in mind. Today TRIZ is applied to different fields after its initial development in the context of technical inventions and engineering. Such disciplines include the arts, education, STEM subjects such as biology and many others. One more field which is relying on constant innovation is business. The next section will describe how TRIZ was adapted for business and management.

2.3 TRIZ in the Context of Business and Management

In the following section the idea behind the usage of TRIZ and its tools in the context of business and management is outlined. The book "Hands-on systematic innovation for business and management" by Darrell Mann serves as the basis for this [8]. In this paper the introduced concepts and adjustments of Classic TRIZ from Manns book will be referred to as "Business TRIZ" in accordance to Souchkov [10, p. 2]. In the business context TRIZ can "support analytical and creative phases of innovation with systematic knowledge-based support" [10, p. 2]. Early research on how to apply TRIZ to businesses focused on the evolution of organizations in comparison to the evolution of systems in the understanding of TRIZ [11, p. 17]. Darrell Mann started to publish his work on TRIZ in 2002. One of his first publication was a proposal to integrate TRIZ and contemporary design strategies in the field of engineering [7].

The monograph "Hands-on systematic innovation for business and management", published in 2009, pushed the idea further to look at TRIZ as a method and toolkit which can be applied to any given context. On an abstract level this idea itself is a part of the systematic thinking of TRIZ, as the systematic analysis of inventions demonstrated that innovation often happens when an innovation is taken out of the current context and applied to a new context or field. However the methods of Classic TRIZ are derived from analyzing technical patents and finding shared principles systematically. Mann adapts the methods of Classic TRIZ and develops them to be able to define and solve problems in the context of business and management. This includes the tools, strategies and theories of Classic TRIZ for problem definition, problem solving and solution evaluation. Souchkov points out the importance of the monograph for active experimentation in the industry and calls it a "major step in further promotion of Business TRIZ" [10, p. 2]. The title of the book already stresses the importance of experimenting and applying the outlined methods when talking about the "[h]ands-on systematic innovation". However there is a conceptual consideration of the application of aforementioned methods.

When working within the context of business, planning a transformation of current systems is usually performed by managers. But in comparison to technical systems, the conception of a socio-technical system is seldom possible in a stasis. Usually, the organization is already in place and operating, planning the organization as a system from scratch only happens when starting a new business.[2] Formal and informal structures and processes are forming an operating system. Hence the dynamics of an ever transforming system makes planning and managing in a systematic more complex. Spotting problems and analyzing them in depth needs a description of the system,

[2]Zlotin et. al. mention the application of TRIZ to start-ups [11, p. 38]. A common practice outside of the context of TRIZ is the "lean start-up" [1]. The business model serves as a demarcation of the business, parallel to the demarcation of a system in the context of TRIZ. The emergent function of a business can be compared to the "unique value proposition" or innovation. However, this method does not focus on relations and contradictions between the different components of the business model and does not propose a systematic approach to innovation.

but already two different stakeholders in a company can have substantially different perspectives on a alleged problem.

Furthermore managers need to be aware that they are part of the system and any description of the system is harder to perform from within the operating system. To be able to perform the task of reducing the system to its essential relationships best, the manager would need to step out of the operating system and look at the system and their own role within the system. In reality this is hardly possible to the same extent as in the context of technical systems, which can be engineered before being put into action by an individual or a team which is not necessarily part of the system.[3]

One concept from TRIZ which can be helpful to describe a long-term goal and perform the reduction of the system to essential components and relations in an operating system is the Ideal Final Result.

2.4 Ideal Final Result

In Classic TRIZ the Ideal Final Result (IFR) is induced from the understanding of the system. In an ideal state, a system should perform as following [6, p. 37]:

$$Ideality = \frac{Benefit}{Cost}$$

The cost can be understand as any effort or use of energy which is needed to operate the system. The goal is to minimize the cost and maximize the benefit for a system which is closer to the ideal state. This ideal state would mean the system is functioning without any input and still producing the desired output - the emergent function should be realized by itself. Koltze and Souchkov point out an ideal technical system, which they equate with an ideal machine, would therefore mean the ideal machine is no machine [6, p. 40-41]. Although this cannot be reached in most circumstances, the projection of the system in an ideal state helps to envision a long-term guideline for the transformation of the respective system, a kind of "beacon". The IFR

[3] As mentioned in section 2.1, Gräbe argues that technical systems are socio-technical systems "in their performance dimension" [2]. Here we are referring to the dimension of planning and describing a system and the desired change. This section aims to juxtapose the focus of Classic TRIZ on physical objects with the focus of Business TRIZ on organisations, therefore the previous observation is left aside partially.

focuses on this ideal state of the system and defines the IFR as a system where the problem is solved completely with the least amount of changes of the system [6, p. 42]. So when designing and transforming the respective system you should strive for the IFR. This sets the context for finding the relevant problems and enables you to apply the methods and tools of TRIZ. The IFR is an integral part of Classic TRIZ, but is slightly adapted by Mann for Business TRIZ [8, see chapter "Problem Definition – Ideality/Ideal Final Result", p. 164-p. 183].

Mann defines the ideal state, ideality, for the usage in Business TRIZ as following [8, p. 164]:

$$Ideality = \frac{(Perceived)\ Benefit}{(Cost\ +\ Harm)}$$

When adding the aspect of "perception", Mann adapts the definition to respect the reality of business: Different stakeholders can have different perceptions of the benefit of a system. This is outlined in the chapter "Problem Solving Tools - Measurement Problems" which talks about the aspect of perception in detail [8, see p.353-367]. Nevertheless he stresses the importance of ideality as the goalpost in which the evolution of the system should be actively directed. The IFR is juxtaposed with the design principle of "continuous improvement". According to Mann this will always lead to diminishing returns in the process of optimizing the system, while the cost of improvement gets greater. If applied successfully, IFR can serve as an "flash of inspiration" and elevate the system by being actually innovative [8, p. 165]. To be able to apply the IFR in the context of business and management, Mann provides a questionnaire with seven questions [8, p. 168]. They are meant to be answered in sequence and should serve as a link to the problem solving tools.

In the proposed process of Classic TRIZ the IFR serves as a guide for the further evolution of the respective system. As Koltze and Souchkov put it, "technical systems develop themselves in the direction of improved ideality" [6, p. 42]. They see this as an universal law of evolution in the context of technical systems. The IFR is integral to the process, as the "ideality [of a system] is an universal target agreement, which mostly retains validity independent from the context of time and the market" [6, p. 44]. In contrast to the central role of IFR in the context of technical systems, Mann declares that in the context of business, the IFR is rather recommended than stricly necessary. He justifies this with the "pragmatic demands a given problem situation; put simply, many problems do not permit us the freedom to throw away all that has gone before in order to pursue what, inconveniently, turns out to be a more ideal solution route." [8, p. 164]. This is crucial for the further discussion of his proposed solution for resolving contradictions, specifically the fourth principle "Transition to an alternative system" (see section 4). But we need to examine the understanding of contradictions in the context of TRIZ beforehand.

Chapter 3

Contradictions

Working with contradictions is essential to the TRIZ framework. When the systematic approach is followed, the practitioners describe the system they are working with and defines the problem with the tools of TRIZ. The Ideal Final Result is defined and serves as a beacon for the long-term development of the system. In this moment the practitioners should be faced with an ideal state of the system and a well-defined problem which needs to be solved. This problem can always be expressed in terms of contradictions, although it might be necessary to reformulate the problem. We will come back to the thought of reformulating the problem in section 4 and look at how TRIZ understands contradictions first.

3.1 Contradictions in the Context of Classic TRIZ

In accordance to the systematic approach of TRIZ, the understanding of contradictions is also based on systematic research and analysis. One similarity of the analyzed inventions was the inherent property to resolve a contradiction. If a system was evolved with a strong inventive solution, there was always a contradiction in the system beforehand [6, p. 24]. Therefore the systematic approach of TRIZ focuses on resolving contradictions within a system. When the underlying contradiction of a problem is identified, the problem is broken down into its most concentrated form. This makes the search for a strong inventive solution easier as recognizing the problem in this form helps to focus on a solution which brings the maximal benefit [6, see p. 65].

Souchkov defines a contradiction as "a situation that emerges when two opposite demands have to be met in order to provide the result required" [9, p. 271]. To elaborate on this definition: A component of a system or its properties (also referred to as "attributes", see [9]) can cause positive and negative effects. Classic TRIZ refers to this entity as a condition which can be measured or described as a parameter. This condition enables different effects within the system. When the problem is formulated in these terms, the positive and negative effects are opposed to each other and we end up with a contradiction: We want the parameter to be minimal and maximal at the same time, to get the minimal unwanted effect and the maximal desired effect [6, p. 65].

Classic TRIZ distinguishes three types of contradiction: Technical contradiction, physical contradiction and administrative contradiction. A technical contradiction "emerges when an attempt to solve an inventive problem by improving a certain attribute (parameter) of a technical system leads to unacceptable degradation of another attribute (parameter) of the same system" [9, p. 272]. Opposed to this, a physical contradiction "emerges when a certain attribute of a material object (represented as a substance or a field) must have two different (or opposite) values at the same time to provide a result required" [9, p. 271-272]. An administrative contradiction describes a situation where a negative effect is caused by an attribute. Strictly speaking this is not a contradiction but a unwanted side effect.

3.1.1 Working with Contradictions with Classic TRIZ

The analysis of TRIZ shows there are patterns and rules to the resolution of contradictions. The systematic research of inventions which serves as a foundation for TRIZ identifies 40 inventive principles to resolve technical contradictions. In accordance to the methodology of TRIZ these inventive principles were compiled by analyzing technical inventions and then generalized. They are independent from specific problems and serve as a design guideline for a specific solution - they are a core tool within TRIZ and enable the step from abstract solution to specific solution. To enable working with the inventive principles efficiently, the most common parameters are combined with the inventive principles in a matrix. This so-called "contradiction matrix" features inventive principles for each combination of all parameters, where one parameter is improving and the other is worsening. The contradiction matrix is compiled according to the application of the inventive principles: The principles are the ones which are most often used to resolve the contradiction of the respective two parameters and are ordered by frequency of use [6, see p. 95-100].

In a situation where a certain attribute should be minimal and maximal at the same time, we encounter a physical contradiction. First and foremost it is important to define the physical contradiction as two opposing values of one parameter of one component [6, p. 67]. To resolve physical contradictions, the theory of TRIZ proposes *separation*. The general strategy to separate the attribute in a dimension helps to find an inventive solution. There are four different dimensions which can be separated, named the "separation principles": [6, see p. 106-107]:

1. Spatial separation - *where?*
2. Temporal separation - *when?*
3. Structural separation - *how?*
4. Separation by condition - *under what condition?*

In the moment of separation of the respective attribute the system is changed and takes a step in its evolution. To separate a system spatially, the system needs to be divided into subsystems and the contradicting attributes are assigned to the different subsystems. When separating a system temporally, the contradicting attributes come into play at different points of time. For a separation by structure, the system is changed structurally - this means the system is divided into subsystems and each subsystems respect one condition of the parameter while the system as a whole respects the other condition of the same parameter. If the separation is done by condition, the system is changed based on a condition to allow the positive effect and avoid the negative effect [6, p. 108-112].

Generally it is advised to apply the separation principles in sequence, as a spatial separation is usually easier to accomplish than a temporal separation, which is easier to accomplish than a structural separation and so on.

Koltze and Souchkov also advise to combine the strategies of inventive principles and separation principles. Often the physical and technical contradictions are closely related in technical systems [6, p. 113]. This hints towards the option to reformulate the problem and is picked up by Business TRIZ.

3.2 Contradictions in the Context of Business TRIZ

In "Hands On Systematic Innovation For Business and Management", Mann works on an adaptation of Contradictions. He stays true to the definition of a contradiction from Classic TRIZ (see 3.1). Throughout the book he emphasizes the importance of contradictions and their resolution for systematic innovation [8, see p. 24, 31, 56–57, 223]. The adaptation of Classic TRIZ to the context of business and management is outlined in the chapter "Problem Solving Tools Contradictions". Mann highlights the systematic approach to contradictions as a feature of TRIZ. According to him, the focus on contradiction resolution is not common in the world of business. More often, the managers would try to find a compromise. As outlined in 2.3 the approach of TRIZ is viewed as fruitful to transform a system in a more meaningful way than optimization. Mann even goes as far as to say the resolution of contradictions "can very often be sufficient to deliver a paradigm-shifting innovation" [8, p. 223].

To operationalize the methods from Classic TRIZ in business, he also distinguishes two different types of contradictions, but offers an alternative terminology: "trade-off" and "contradiction". A trade-off, also called "conflict", is defined as a situation "where there are two different things in conflict with one another" and a contradiction is defined as a situation "where there are contradictory requirements concerning a single parameter" [8, p. 223]. This can be seen as a parallel to the two types from Classic TRIZ, technical and physical contradiction. In Manns understanding, the conflict parameter of trade-offs and the single parameter of contradictions are linked by an logical "AND" - we want to have two effects at the same time, or we want to maximize and minimize a parameter at the same time. Following this understanding, trade-offs and contradictions can be reformulated as each other. He provides a method to convert conflicts to contradictions and vice versa: Define a successful outcome and analyze the situation: There are the two parameters which are at conflict, which can be traced back to one parameter. "Personalisation" is provided as an example: We want a system which provides a rich experience for users, but we also want a system with maximal reach. These two effects of personalisation imply we want the system to be personalized to provide the richness and at the same not personalized to provide more reach. According to Mann, the contradicting parameter causes a positive effect and the successful outcome requires this parameter to be absent or minimal at the same time. The effects, formulated as a trade-off, are related to the desired outcome by the terms "because" and "requires". In the example of personalisation, we want a personalised system because it provides a rich experience which is our successful outcome. At the same time, our successful outcome is defined as maximal reach, so we need the system to be not personalized. This method extends the understanding of Classic TRIZ, where a physical contradiction is also linked to a technical contradiction by the positive and negative effect of one parameter, by the relationship of "because" and "requires", i.e. of cause and requirement. Furthermore the method enables the reformulation of the situation and the application of the tools for trade-offs and contradictions.

In the last section of the the chapter "Problem Solving Tools - Contradictions", the aspect of perception is brought up [8, p. 349-351]. Mann points out the importance of perception in the business context. This alludes to the aspect of reduction (also see 2.1). Reduction to describe the system can be seen as analogous to the concept of "map" and "territory" [8, p.350]: The territory is seen as the objective reality, whereas the "map" can be different depending on the perspective of the respective stakeholder. This becomes more important in the business context as there can be a multitude of different perspectives even within a singular organization. When working with technical systems, the reduction of describing a system can be based on measurements and tangible design choices, while in socio-technical systems the units of measurement can be problematic due to different interests, and the structure of the system is partially evolving by itself.

With this theoretical background, we can focus on the proposed way to resolve trade-offs and contradictions next.

3.2.1 Working with Contradictions in Business TRIZ

This section will focus on the separation strategies to resolve contradictions (*contradiction* refers to the term in the understanding of Business TRIZ here). But a brief overview of the tools to work with trade-offs is necessary to understand the framework proposed by Mann: The contradiction matrix is also used in Business TRIZ to resolve trade-offs. It is renamed to the "Business Conflict Matrix" and includes 31 parameters which are relevant to business and management. The parameters are categorized into five distinct fields: R&D, production, supply, support and the customer [8, p. 227]. This helps to understand the relationships between the different parameters better and to navigate the matrix more easily.

Furthermore the inventive principles are also grouped into five categories: "Segment or merge", "Make the entities bigger or smaller", "Change the external form", "Change the internal structure" and "Substitute the existing structure for something else" [8, p. 246]. The aim of this categorization is also to help understanding the strategies better and make them more accessible. In the review of TRIZ in practice, Ilevbare et. al point out the difficulty for beginners or people from non-technical backgrounds to apply TRIZ in a meaningful way [5]. This categorization can be seen as an attempt to simplify the complexity of Classic TRIZ and prevent the feeling of "confusion over knowing what methods to apply from the apparent lack of structure or clear instructions within TRIZ on when and where to apply each of its tools" [5, p. 36].[1] The apparent lack of structure is needed for flexible innovative thinking in the context of engineering and technical systems, but can be detrimental for (new) practitioners in business.

To resolve contradictions, Mann also refers to different types of separation. He adapts the strategies from Classic TRIZ and describes four different strategies:

1. Separation in space - *where?*
2. Separation in time - *when?*
3. Separation on condition - *if?*
4. Separation by transition to an alternative system

In the context of Business TRIZ, the list is hierarchical. When looking for strategies, one should follow the list top-to-bottom and prioritize separation in space over time, time over condition and so forth. The fourth strategy is specific to Business TRIZ. It is introduced to help if the three prior strategies

[1] Ilevbare et. al. propose the use of ARIZ as an solution, but acknowledge that ARIZ tends to be "too complicated for most problems" [5, p.36]. This is in line with the opinion of Mann who also claims ARIZ "has shown that it fails to offer the necessary flexibility and ability to handle the complexities and 'fuzziness' inherent to many problem scenarios" in business [8, p. 500].

cannot be applied. However the strategy is not elaborated upon with any theoretical or methodical backing.[2]

For the application of the separation strategy, there is a list of separation strategies and the inventive principles which can be used to apply the respective strategy [8, see p. 341-342]. The list is compiled by analyzing other cases and is ordered by frequency of application. In the list, the fourth strategy of "Transition to Alternative System" is divided into four sub-strategies [8, see p. 342]:

1. Transition to Sub-System
2. Transition to Super-System
3. Transition to Alternative System
4. Transition to Inverse System

For each sub-strategy there is a hierarchical list of inventive principles supplied which promise the most success during the process of systematic innovation. It is not clear if the sub-strategies themselves should be also applied in order when looking for a way to transition to an alternative system (i.e. "Transition to Sub-System" should be applied before "Transition to Super-System" and so on).

The separation strategy "Transition to Alternative System" can be seen as a helpful addition to the existing tools of Classic TRIZ, adjusted for the business context. But the strategy serves as a backup when all other separation strategies fail and is not described extensively. In the next chapter, we want to look at the implications of this strategy and relation to the theories and tools of Classic TRIZ.

[2] In the context of separation strategies, Mann claims the "best way to understand [...] the contradiction solving part of the [...] toolkit is to see it in action" and "we should focus on the process" [8, p. 342]. This emphasizes the focus of the book to present a framework which can be applied in the context of business and management yet again.

Chapter 4

Discussing "Separation by Transition to an Alternative System"

This chapter focuses on the question what the fourth strategy "Separation by Transition to an Alternative System" actually entails. As it is introduced as a strategy to eliminate contradictions, it is part of an essential tool in the toolkit of Business TRIZ. The systematic approach of Classic TRIZ stresses the central role of eliminating contradictions. In the following we want to discuss how the addition of the aforementioned strategy relates to the different theoretical parts of Classic TRIZ.

Transition to an Alternative System and the strategy of "structural separation" of Classic TRIZ As detailed in section 3.2.1, the Transition to an Alternative System is comprised of four different sub-strategies. The strategy of structural separation is also divided into four different sub-strategies: "Combination of homogeneous and heterogeneous systems in the supersystem", "Transition from System to Anti-System or merging", "Separation in structure" and "Transition to micro-level". There are seemingly similar sub-strategies proposed by Classic TRIZ and Business TRIZ, but are bundled under different umbrella terms: Transition to an Alternative system versus a separation in structure. The difference becomes more apparent when looking at the standards from the "76 standards" which are referenced as beacons for the respective sub-strategies form Classic TRIZ: Although they redefine the respective system, they focus on the structure of the system [6, see Standard 3.1.1, 3.1.3, 3.2.1]. They are not striving to swap the system or replace the system (or the sub-system or super-system), but complement it with an additional system - so the system is connected and related with another system in some form, but the components are still definable and previous relationships are respected (or actively transformed). When looking at the strategy "Transition to an Alternative System", the focus is the *transition*. This can bring a change in structure of the system with it, but this change would be a side-effect. The strategy strives to redefine the system by replacing, inverting or dividing the system. This means the relations from system and environment could be changed drastically, especially in the context of socio-technical systems and informal processes in an organization.

An actual separation in structure would mean to actively redefine the system, its components and the relationships between them. This is hard to achieve in the context of business and management, as the pracitioners of Business TRIZ always have to work with a dynamically evolving system, e.g. a company or an organization. Therefore the necessity of the transition, which is dynamic in itself, becomes clear. Nevertheless the separation in structure could be applied to socio-technical systems, when the relations of the respective systems are integrated into the approach of systematic innovation. An example would be a company which needs to be more flexible in developing new products and needs to be more financially stable at the same time. This can be traced back to the parameter of the layers of management (or formal organization) within the company: The hierarchies should be as flat as possible to allow for more flexibility, while the layers of management should be structured strictly hierarchical to assure maximal control over the budget. Separating this system on the level of structure, you could restructure the departments responsible for developing new products with flat hierarchies, and the overall hierarchy in the organization (i.e. the departments) in a hierarchical manner. This would be a combination of the strategy to separate by structure and by transitioning to a sub-system. In this case you would need to actively design the relationship of these two different structures, which would not be considered when just transitioning to a different system in some way. This illustrates the subtle difference between the two separation strategies.

Transition to an Alternative System and the "operating principle" Souchkov and Koltze also discuss the elimination of contradictions by changing the operating principle [6, p. 115-116]. This entails a change in the principle under which the current system is operating. The current physical contradiction is not really eliminated by resolution of the contradiction, but the physical contradiction is eliminated by shifting to another operating principle. This could be seen as an analogue strategy to the "Transition to an Alternative System". Moving from one operating principle of a technical system to another technical system also means changing to a system which operates differently - otherwise the system would stay the same and another strategy of separation would be applied. Finding and defining the "operating principle" in the context of Business TRIZ seems to be a hard task, as the respective systems usually incorporate many different operating principles. But with this concept in mind, the transition to an alternative system can be seen as a change in operating principle of the system (or sub-/supersystem). The transition to an inverse system illustrated this well, as the operating principle is inverted and therefore a new system emerges which can be transitioned to. The shift to another operating principle also takes the entailed change in relationships between components resp. the system and the environment into account.

Transition to an Alternative System and the context of contradiction elimination To eliminate contradiction in the context of business, the "flashes of inspiration always come from [...] outside the existing range of current providers of a product or service" according to Mann [8, p. 165]. When thinking this thought through to the extreme, this would mean for socio-technical systems with many components that the transition to an alternative system could provide this flash of inspiration. For example, the technical infrastructure of a company could be seen as an integral sub-system of the bigger system *organization*. To achieve a better output of the whole system while keeping the infrastructure up and running, the transition to a newer, more effective and efficient technical infrastructure would be a sufficient solution to eliminate this contradiction. Even if the integration of the new system would come with no additional costs, this would be not a strong inventive solution. The "flash of inspiration" is not inherent to the "Transition to an Alternative System", while the other strategies of separation need actual mental work to describe the problem situation and find an inventive solution with the toolkit provided by TRIZ.

Additionally the transition to another system can create new unforeseen contradictions. This is not mentioned by Mann and should be mentioned. Practitioners of Business TRIZ need to be aware that the elimination of contradiction by swapping out the system in its performative state can yield new relationships between components and new contradicting effects. To put this strategy to work, they need to be experienced with Business TRIZ and closely familiar with the components and relationships of the respective system.

Transition to an Alternative System and the Ideal Final Result For Classic TRIZ, the IFR serves as a long-term guide for the evolution of a system. Business TRIZ in the understanding of Mann acknowledges the usefulness of IFR as a beacon for further development, but states that IFR cannot be always applied at the same time. This already hints at the central problem of the strategy to "Transition to an Alternative System" and the IFR. In Classic TRIZ, the definition of ideality and the IFR is integral to the process of applying TRIZ. Furthermore the IFR is based on the description of the system, which is in contradiction with the reality of business. Organizations are always operating and the description needs to be adapted constantly, and as outlined before, it is also hard to make measurements. In this situation the IFR needs to be revisited when transitioning to an alternative system in one way or another. This is also supported by the formal understanding of ideality: The goal of the transition is to eliminate a contradiction to increase the desired output, which is influenced from the idea of ideality. The perceived benefit should stay the same, while a transition to another system always means a change in the cost and harm of the system. Therefore the ideality would also change and the IFR would be in need of a redefinition.

Transition to an Alternative System and the system In the context of the system, the transition to an alternative system means the redefinition of previous relationships between components and possibly even a need to define the demarcation of the system from the environment again. In technical systems, it is possible to demarcate the system from the environment by abstracting the essential parts of the system. Furthermore we are able to describe each component and define the desired outcome of the system. With this step the system becomes decomposable. This also enables the definition of the emergent function of the system. In the context of business and management we are working with socio-technical systems, especially organizations. They are per definition always in the performative and operating state. Therefore, the system "organization" is indecomposable. The transition of a system in operation to another system becomes harder to plan and control, at least with the tools provided by TRIZ. In an ideal world it would be possible to re-describe the current system in the moment of transition, but in practice this is hard to achieve due to the nature of organizations. The transition to an alternative system can be seen as a pragmatic solution, and Mann himself stresses that this should be considered when all other strategies of separation are not applicable.

From a critical perspective, transitioning to an alternative system can also lead to a step backwards in the cycle of the evolution of a system. When swapping out the whole system, regress on the level of the system is possible. However this might be necessary in business sometimes, as there could be situations where the limit of the current system is reached and a less evolved system would supply the desired outcome [8, also see p.246].

A short observation on the "Transition to an Alternative System": This approach could also turn cynical quickly in the context of business and neoliberalism. We do not want to focus on the general tendencies of estrangement of workers in capitalism, but as a short illustration: When thinking about the Transition to an Alternative System in the context of an organization, the proposed solution for the sub-strategy "Transition to an Alternative System" according to the list of inventive principles would be inventive principle 27 ("Cheap/Short Living" or also "Cheap Disposable") [8, p. 331, 342]. With this principle you could justify wage dumping, outsourcing to third-world countries or union busting easily.

Transition to an Alternative System: Alternatives The chapter illustrates the difficulties associated with the transition to an alternative system. In the Business TRIZ toolkit of systematic innovation, the strategy seems to be not as well grounded in the theory of Classic TRIZ and not as sharply defined as the other separation strategies, which were adapted from Classic TRIZ. It would be helpful to adapt the sub-strategies of the "separation by structure" from Classic TRIZ to Business TRIZ and combine it with the pragmatic approach of the strategy "Transition to an Alternative System". The pragmatism of the strategy and the problems associated with it could also be seen as a reason to fall back to a reformulation of the respective contradiction as a trade-off - this would enable the practitioners to work with the tools for trade-off elimination.

Otherwise a method or tool to compare the current system to the proposed alternative system (and the respective sub-, super- or inverse systems) would be helpful, as well as a framework to estimate the cost of the proposed transition. This could be achieved by the same means as the theories and methods Classic TRIZ was developed: by systematically analyzing best practices from Business TRIZ and finding the patterns. Business TRIZ, at least as described in "Hands-On Systematic Innovation for Business and Management", would benefit from the results of such an undertaking and the associated new insights about the theoretical foundation.

Chapter 5

Conclusion

In opposition to the proverb "Never change a running system", which is also commonly used in the context of technical systems, we want to actively change the system and push the evolution of said system. Classic TRIZ enables this for techinical systems and Business TRIZ adapts the methods to the context of business and management. The ability to eliminate contradictions is essential for systematic innovation. To be able to apply the methods from Classic or Business TRIZ to eliminate contradictions, the definiton of the system and the problem needs to be clear. Business TRIZ suggest the strategy to separate a system by "Transition to an Alternative System". The strategy is already introduced as a fallback when other strategies of separation cannot be applied. When looking at the theories and methods of Classic TRIZ, especially at the proposed tools for elimination of physical contradictions, the Ideal Final Result and the notion of the system, the difficulties to apply the separation by "Transition to an Alternative System" in a truly systematic way become apparent. A redefinition of the respective system and the IFR should not be necessary when eliminating contradictions. The application of the aforementioned strategy also is complicated by the inherent dynamics of socio-technical systems in the business context.

"Transition to an Alternative System" is useful as a last resort when other strategies cannot be applied in the business context. Therefore we might adapt the proverb to "Never swap a running system (unless you are out of options)".

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